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*THE AMERICAN SOCIETY OF NATURALISTS. WHAT ACADEMIC DEGREES SHOULD BE CONFERRED FOR SCIENTIFIC WORK?**

THE CHAIRMAN (PROFESSOR TRELEASE):

The subject that has been selected for the afternoon's discussion is one of very considerable interest to all of us as investigators, and further, to those of us who are teachers as well—the question as to what academic degrees should be conferred for scientific work. From the time when one of our little people comes home from the primary school with a long narrow strip of yellow paper with various hieroglyphics on it that he has made himself, and with certain blue pencil marks which may read 100, or 90, or 40, we are confronted by one phase of the question that we are to analyze this afternoon. The arithmetical grading of our attainments and our personality begins at the very moment that we go into the kindergarten, and it does not end until a well-disposed clergyman tries to find something good to say of the worst of us when we are through with our life's work. Everywhere between the kindergarten and the grave we are confronted with the fact that a kind of stamp is put upon us in every one of the complications of life that we may fall into.

What are we trying to do as teachers is of course perfectly clear to every one of us. Those of us who are teachers are trying to equip people for useful work in life. The situation is not unlike that of cur-

* Annual discussion, St. Louis meeting, December, 1903. Reported stenographically and corrected by the speakers.

rency in China. I had the pleasure a few weeks ago of listening to a very instructive address on Chinese banking by a scholarly native of that country, who reminded us of the time, in the seventies, when one of our New England firms thought that it would be a very nice thing to take over a lot of trade dollars—a thousand or more, to China, in order that the good standard coin, stamped with the sign manual of a good responsible nation, might be passed into the Chinese circulation, but he stated that before these trade dollars had been in China a month they were all melted down into bullion and the bullion was cast into the 'shoes' current in China—stamped with the imprint of the firms which chose to make them up in this form and guarantee their purity and weight. Now I take it that in this matter of the stamp of educational institutions we are really dealing with the same kind of currency question. Those of us who are called on to train men are turned to for an expression of opinion as to what those men are worth, and whatever that expression of opinion may be, and the value of it, are largely a matter of the convenience of the people our men may be thrown in with afterwards. I think we recognize that all of the percentage gradings, and all of the academic distinctions and classifications, and all of the honors that come in middle and old age, are merely expressions of belief; that the real thing we are trying to do is to make men useful, and that all marks of approval are merely secondary, accessory matters.

If we are agreed on this, however, I think that we are agreed that although evils, they are for the time being necessary evils. It does seem necessary that there should be a good deal of this vouching for people. With the greater complexity of our civilization and of our educational institutions, it becomes more and more necessary, apparently, that there shall be some of this sort of secondary designation, other than that which men can give themselves by going into the market and performing life's work; and for that reason we have this very question of degrees standing out prominently before us as investigators and teachers.

The subject that is before us this afternoon is one that can be made a very fruitful subject of discussion, not with reference to any action that the American Society of Naturalists may take in regard to it, not, perhaps, with reference to individual action that any society may take, but that through discussion some of the undesirable features of the present practise may in time be remodeled and replaced by a greater simplicity, and with a greater expressiveness, perhaps, in what is done.

With this preface to the work before us, I wish to call upon the first of the speakers who have agreed to take part in the discussion this afternoon, President Jordan of Stanford University.

Dr. Jordan:

Mr. Chairman, I was rather hoping that somebody that did not agree with us would come in between you and me, so that I might have something to stir me up to a little enthusiasm, something that would remind us of the old times when Professor Coulter and I fought on the bloody sands of Indiana against most of the other schoolmen of that state.

I have felt in regard to degrees very much as Caligula did when he said that he wished the Roman people had but one neck, so that he could despatch it with one blow. I have felt that it might be well if the degrees could be unified, and, taking them all together, we could abolish them at one blow. But doubtless, as the president has said, the degree is among the necessary evils of our time. Certainly no one institution could abolish degrees without distinct

disadvantage to its students, putting them in the position of eternally apologizing for the fact that they have no degree. The essential matter in regard to degrees, which should always be kept in mind, is that the student should not go out of his way to get a degree. It is a crime in education to force a student to do something that is not the best thing for him, merely to conform to some system. The individual is a thousand times more important than the system. Our work as teachers is really the work of training individuals, not to make them conform to a system unless the system helps on their work. In all of our treatment of degrees we should keep that principle in mind—that the student ought not to go out of his best way. How that best way is to be judged is another question, but there is always one way better than other ways for each particular man.

I believe also that the degree should not be made too much of, and that we should not regard it as something particularly vital. It is simply a handy term for the registration of alumni. I do not believe in making the degree a class label. One reason for separating the degree of A.B. from other bachelors' degrees has been the supposed superiority of the men of classical training. If the classical graduate is really superior, the fact will show. If he is not superior except in name, the assumption that he is so would tend to make him ridiculous. We know as a matter of fact that there is no superiority of classical training over other forms of training for all classes of men. We know that there is no kind of training better for all men than every other form.

I believe very strongly that it is best as a matter of policy for an institution to give the same bachelor's degree for all kinds of academic work that may be approved, whether it be scientific, or classical, or literary, or historical, or whatever it may be. Let the four years' course be marked by the degree of bachelor of arts—of arts because that term is one of long standing, long used in connection with college graduation. Its historic meaning is long since lost, and does not concern us vitally. Of course, the classical course of to-day is not the course of a hundred years ago. There is no historical value to the A.B. There are good reasons why the graduates of one institution should bear the same title. If one wishes to be more explicit, it is easy to specify on the diploma which has been the major subject.

As we know, the degree of B.S. has been and is grossly abused. It is given for short courses on insufficient preparation. It usually means bachelor of surfaces instead of bachelor of science, indicating that the bearer of it has none but superficial knowledge.

The degree of A.M. is a harmless one which means nothing in this country. In some institutions it costs five dollars, in some others two years of study. In some universities it is a step toward the degree of doctor of philosophy, and in other places it is a name for culture work of some kind or for training as a high-school teacher. We had a discussion in the Association of American Universities a while ago, spending several hours on the meaning of the master's degree. The discussion seemed to show very clearly that the degree had no uniform significance. On the average it was simply a convenient way to bring graduate students from other institutions into the roll of alumni of an institution in which they had done advanced work.

The degree which has most significance is that of Ph.D., one which we have brought from Germany. This is essentially a professional degree, the degree of the professional scholar, the professional investigator, as distinguished from the men who are not making their scholarship a profession. Professional degrees are the only ones with

permanent significance and the professional degree of doctor of philosophy should find its cognate in doctor of medicine, and the professional degree of law. Scientific degrees should be called by the same name as any corresponding degrees in scholarship. We should not attempt to split up our courses, separating scientific men from the other men. I think any distinction by way of degrees and badges is rather unfortunate, but that we should grant to all persons with high scholarship the same names and titles so far as these have any value at all. At present professional degrees have very different values. Some are university degrees, representing the professional training of an educated man, and some are trade degrees, showing that a man with or without education has attended lectures and learned something of the trade. The professional schools of some of our universities say: "There are so many men going to be doctors, or lawyers, willing to enter the study of medicine or law at such and such a time for such and such a period. We will take them for what they are and do the best we can for them." The university of higher aims seeks for the best way to train a good physician or lawyer and requires its students to take that kind of training. So long as we have professional schools fitted for such different classes of students, and still lower for persons who can not be called students at all, we shall have a great difference in the value of professional degrees.

I may repeat that I believe that the policy of Johns Hopkins, Harvard, Cornell, and many other institutions, the policy of unifying degrees, by getting rid of superfluous ones, is a movement in the right direction. We do not need more than two non-professional degrees, A.B. and A.M., and the Ph.D. should go along with the other doctors as a professional degree.

The Chairman:

I have several letters on the table, and before calling on the next speaker, I think that in view of what President Jordan has said, this letter from President Eliot of Harvard will be very interesting to you.

In reply to your inquiry of November 18, I beg to state that in my opinion, the best degrees to confer for scientific work, as for all other work, are the degree of bachelor of arts, the degree of master of arts and the degree of doctor of philosophy. In a temporary and provisional way the inferior degrees of bachelor of science, master of science and doctor of science have been used—with some variations of name and corresponding letters—in our country, because the preparatory work at school required of candidates for these degrees has been smaller in amount and inferior in quality than the work required of candidates for the traditional degree of bachelor of arts. This relative inferiority of the scientific degrees now begins to be overcome. When it is overcome there will be no reason for persisting in the special degrees which have the word 'science' in their title. More and more the equal dignity and value of the scientific subjects in comparison with the humanities is recognized. When that recognition is complete and universal, there will be no need of giving one degree for excellence in languages, history or philosophy, and a different degree for excellence in economics, architecture, chemistry or zoology. All good work, in whatever field, ought to be rewarded by the same academic distinctions.

For these reasons I consider separate degrees for scientific work to be undesirable, although provisionally necessary. They have heretofore been degrees of lower standing or repute, and they are likely to continue to be so regarded. I hope that they tend to be abolished. Will you kindly accept this statement as my contribution to the forthcoming discussion before the American Society of Naturalists?

The next of the gentlemen who have agreed to speak this afternoon is President Van Hise of the University of Wisconsin.

President Van Hise:

In considering the subject of degrees, I have thought rather of the trend of development than of what might seem desirable. As all are aware, the A.B. degree

was that of the classical colleges. The B.S. degree arose, as President Eliot has said in his letter, because those interested in the studies leading to the A.B. degree were not willing to accept work in science as equivalent to the traditional curriculum. It is comparatively recently that science work has been generally recognized as of equal cultural value with mathematical and classical studies; only recently that many institutions have come to the point of placing all liberal studies upon the same basis with reference to the A.B. degree. This came about when it was seen either that there must be a degree for every group of studies, or one degree for any group of liberal studies. This was not at first appreciated, and various degrees were introduced for different groups of studies. But when the logical result of this practise was understood, various institutions turned to the A.B. degree for all work of a general cultural nature.

But President Eliot holds that courses in chemistry, architecture, and by implication all courses in applied science, should also receive the A.B. degree. I do not know that I am prepared to go so far as to say that technical training in applied science should lead to this degree. Certainly recent development in this country has not been in this direction. It is now the practise, at least at many large technical institutions, to give the B.S. degree in applied science. This is illustrated by the Massachusetts Institute of Technology.

Applied science is taught in a somewhat different way, with a different spirit and a different purpose from the general cultural studies of the college of liberal arts. Feeling this difference, various institutions which have gone so far as to give the A.B. degree for all pure cultural work, including science, still give the B.S. degree for applied science. It is at least a question whether there is not a sufficient difference in the method and purpose of the college of liberal arts and the college of applied science to warrant a distinction in the degrees conferred by them. Certainly the colleges of applied science are generally using the B.S. degree. They wish to retain it as a stamp showing that their men are trained in science to a definite end. They do not desire the A.B. degree for the courses in applied science, since they feel that this degree does not express what they desire to say in reference to graduates of agriculture and engineering. It, therefore, appears to me that, for the present at least, the use of the two degrees mentioned is pretty well fixed in this country, *i. e.*, the A.B. degree for courses in the liberal arts and the B.S. degree for applied science.

If for all work in liberal arts the baccalaureate degree is A.B., then for advanced graduate work of a grade showing power of productive scholarship and investigation there should be a single degree, and for this place the degree Ph.D. is preferable, since it is the one in common use both in Germany and this country.

THE CHAIRMAN:

These letters that I have seem to fall in very nicely with the speakers this afternoon. I have a letter from President Schurman of Cornell which I will read now, if I may, as being quite appropriate to the remarks of President Van Hise.

It seems to me that the whole question depends entirely upon the point of view from which one looks at it. A distinction might also be drawn, I believe, between baccalureate and advanced degrees.

If we are to consider, as I believe we should, that graduation from the college of arts and sciences (or corresponding department) of a university signifies, regardless of the nature of the studies pursued previous to such graduation, the attainment of a certain stage of liberal culture rather than the completion of a course of preparation for a specific walk in life, then, it seems

to me, this training is best represented by the degrees of A.B. If, on the other hand, it is desired that the nature of the undergraduate studies shall be specifically shown by the name of the degree, I should think that the nomenclature, B.S., were as satisfactory as any for work in science.

Graduate work, however, is primarily specialization, and, as such, might very well be represented by degrees significant in themselves of the nature of the field covered, although here at Cornell the only advanced degrees now granted by the college of arts and sciences are A.M. and Ph.D. In that case, M.S. and D.Sc. seem to be very appropriate for work in science.

In other words, the line of argument that President Van Hise has presented seems to have been followed by Dr. Schurman.

As the next speaker, I shall call on Professor Cattell.

Professor Cattell:

President Jordan has told us that academic degrees belong to the babyhood of culture, and President Butler has elsewhere called them the tinsel of education. These university presidents, however, continue to confer degrees. They doubtless realize that our civilization is semi-barbarous, crude personal adornment being an important factor. It is, perhaps, a sign of progress to put rings through the ears rather than through the nose; if stays must be worn, those should be chosen that interfere as little as may be with the digestive processes. I should like to see academic degrees abolished altogether, or as a second choice to see the B.A. degree interpreted as meaning either bachelor of arts or bachelor of athletics, as the case may be, and then conferred on each college student when he attains his twenty-first birthday. But no individual and no body of individuals can create a new world; we may try to improve existing conditions, but must at the same time adjust ourselves to them. The question before us is not whether degrees should be abolished, but what kinds of degrees should be conferred for scientific work.

There are four kinds of degrees to be considered—those conferred at the close of the college course, those conferred for graduate studies, those conferred for professional work—all of which are more or less confluent, and lastly the degrees conferred as honors. The American college has performed an important service for the country and deserves the esteem and affection in which it is held. But its functions were local and temporary. We can scarcely imagine its introduction into Germany or France; or its survival here to the end of the twentieth century. The high school will give, and in fact now gives, the general training of the first year or two of the old college course, and after this comes the special training of the university and professional school. A kind of country club for young gentlemen of wealth and leisure is scarcely appropriate to a democratic community. We shall probably give the baccalaureate degree at the close of the school course as in France or abandon it as in Germany.

In the meanwhile what kind of a degree should be given for non-professional scientific work? The choice is apparently between the bachelor of arts and the bachelor of science. If there were exactly two kinds of secondary school and college courses, one based on the classical languages and one on the sciences, it would be proper to give to each its appropriate degree. But such clear-cut courses do not exist. According to the last report at hand, there were at Harvard College 249 elections in Greek and 303 in Latin. Those who elected Greek nearly all elected Latin, and there were not in the twenty-four courses in the classical languages as many different students as in a single course in history, economics or geology. One course in Latin given by three professors, one adjunct professor and

one instructor was attended by three students. There were about two thousand students in the college, electing about ten thousand courses, and the classical languages represented about one twentieth part of the average college education of the Harvard bachelor of arts. This degree means that the student studied Latin at the secondary school, not that he followed a different course in college from that of the student who receives the B.S. degree. But the bachelor of science degree unfortunately does not mean that the student has had a scientific education. It means usually that he has not studied Latin at school and has probably entered college with easier requirements. It is said that to receive the doctor's degree at Heidelberg without honors is a certificate of idiocy. A degree that simply means that a student has not studied Latin as a boy, that his parents did not send him to a fashionable preparatory school, that he perhaps entered college with lower requirements and pursued a shorter course, can scarcely be held in high esteem, and a society of scientific men can not rejoice to see the name of 'science' attached to it.

If we were drawing up a Napoleonic code, probably no one would propose to give different kinds of degrees for different kinds of college work. Where the field was clear Johns Hopkins and Stanford adopted one degree only. Chicago, it is true, took the three conventional degrees, and students of commerce become bachelors of philosophy; let us hope that idealism will be radiated from the packing houses of the city. Cornell, Michigan, Minnesota, Wisconsin, Texas and other universities have abandoned the multiplicity of degrees. In some institutions the professors of classical languages, having lost the substance, cling to the shadow of the bachelor of arts, but unwisely as it seems to me, for their nakedness is uncovered. Thus, according to the last catalogue at hand, there were 2,248 undergraduate students in the University of California, of whom only 284—107 men and 177 women—were in the course leading to the A.B. degree.

I should prefer to see the bachelor's degree conferred with specification of the institution and major subject—bachelor of Harvard in classical languages, bachelor of Michigan in zoology, etc., but this is doubtless out of the question. It seems that for scientific work at college the bachelor of arts degree should be awarded unless the bachelor of science degree can be given a proper standing.

Substantial agreement has been reached in favor of granting the doctorate of philosophy for about three years of graduate work with research, without reference to the direction of work or to the character of the first degree. Harvard, Princeton and one or two other institutions have the degree of doctor of science, but it is seldom conferred. The difference between the D.S. and the Ph.D. at Harvard is that in the case of the former the man may not have studied Latin in the secondary school. Harvard, in order to be consistent, established the M.S. degree three or four years ago, but it was wisely permitted to die in infancy, and the jewel of consistency must be abandoned or secured by doing away with the D.S. The evidence that a man is worthy of the doctorate of philosophy should be given by the publication of the thesis, the appeal being made to experts throughout the work. An oral defense of the thesis before the faculty became antiquated in Germany before we borrowed it. In my opinion the doctorate of philosophy is a professional degree, signifying practically that the recipient is competent to teach and to carry on research in his special subject. All teachers can not be original thinkers, nor should investigation be confined to a few teachers. Physicians,

engineers and others should be educated by research and to research, and there is no reason why they should not receive a degree signifying the accomplishment of original work and the promise of its continuation. The doctorate of medicine has in this country lost any meaning beyond the following of three or four years of routine work. I see no special objection to doctorates of engineering, pathology, etc., but the doctorate of philosophy is quite as suitable. I object to the distinction between liberal and technical studies, as applied to the subject studied, but there is an important difference in the attitude of the student. A student might receive the A.B. or B.S. degree as a sign that he is a well-educated man, and at the same time the professional degree, such as E.E. or C.E., as an indication that he is prepared to practise a certain profession. Then later he could be given the doctorate, if he proved himself competent to advance knowledge.

I am not greatly interested in the question of honorary degrees. I should suppose it might be well to reserve the LL.D. degree for public men, including college presidents and benefactors, and to use the doctorates of science and of letters for the two main lines of productive activity. But, at a matter of practise, the LL.D tends to become a first-class degree and the others second-class degrees. It may seem slightly pedantic for Herbert Spencer to have declined all honorary degrees; but if the members of a society such as this would unite in ignoring them it would be a modest reform.

President Jordan:

May I rise for a few words more? I believe that Stanford University is the only one to grant the degree A.B. at the end of a four years' course of which the major subject is engineering. When the university was organized I wrote its first constitution and put in the degree B.S. for engineering courses. When the faculty met, they decided that the purpose of the engineering courses was not essentially different from the others. They led men toward the profession of engineering. Professor Marx, especially, insisted that the engineering proper should be largely graduate work, and that the spirit of the undergraduate work should not be essentially different from that of other scientific departments. For such reasons the faculty voted to give the degree A.B. for this work. Since then I have not found enough objection to the arrangement to bring the faculty together for a reconsideration. The classical men seem to be satisfied with the thing as it is, and the engineers are looking for the time when engineering shall be a professional subject to be pursued for two years after granting the bachelor's degree. Engineering students are brought more closely to the others by this arrangement, and the more unified the student body is the better. We should have no reason for considering a change unless, as suggested by President Van Hise, all the other institutions should agree to reserve the degree of B.S. for the first four years leading to technical work.

The Chairman:

It seems to me, gentlemen, that these remarks of Dr. Jordan are very suggestive, indeed, as to what is really needed in the entire matter of degrees. The universities of the country which give degrees of course can get together in regard to what they do, and very greatly simplify and very greatly strengthen their attitude in regard to it.

Dr. Cattell has spoken in a very brief way of honorary degrees, and what he said in regard to honorary degrees reminded me of a little experience of my own this last summer. I was botanizing in Mexico, and I ran across a gentleman—a member of the

faculty of one of our large universities—who was prosecuting some field work in another department of science. I had not before met him, but was familiar with his work, and I was rather surprised in the course of conversation to find that he had not the doctor's degree. As he was a young man (men are sometimes compelled by circumstances to take to the harness before they have entirely equipped themselves) and not in what might be called a permanent life position, I was rather surprised that he had not this degree, and when I put a question to him about it, I found that the feeling which has been expressed here in several shapes was very strongly fixed in his mind—that the doctor's degree was hardly worth having, and to him it took this shape: That he was an investigator; he was making his mark; he was getting along; he knew how to do research work; he was already getting recognition as an accomplished investigator; and it was hardly to his interest to make certain sacrifices of money and the disposal of his time that would be necessary in order to get a diploma that would enable him to write Ph.D. after his name. He said: "I have students in my own department who are going to be Ph.D.'s in a short time, but who, I know well enough, will never do a piece of work that I have not thought up and that they do not carry out under my plan. They will get Ph.D.—and of what use is that designation to me?"

This opens one of the very important questions which I hope may come into the discussion this afternoon—that of securing recognition of those professional attainments which distinguish the man who has gone into the field of science from the man who has taken the equipment and bought the armor and weapons but has never gone any farther. And it may be that there is in the future the possibility that the degree which is sometimes conferred for scientific work, doctor of science, which I hold—which I should be sorry to see go, but which is fast becoming entirely obsolete as an earned degree, may be conferred as recognizing the successful investigator in science as distinguished from the gentlemen to whom Professor Cattell would give the degree of LL.D.—almost the one honorary degree that is open to-day for those whose names appear in 'Who's Who.'

The next speaker, who, though not an active college president, has had ample experience as a college president, and at the same time, like all of the speakers, is a distinguished investigator, is Professor Coulter, of the University of Chicago.

PROFESSOR COULTER:

I believe that this subject, discussed in a meeting of scientific people or those who have scientific inclinations, is likely to get the sort of handling it would not get anywhere else. We are really somewhat out of sympathy with a great many of the notions that cluster about these degrees, and in our scientific training we seem to have gotten away from any sentiment that belongs to them; and still it remains a fact that most scientific men, in the back of their minds at least, think a great deal about them. Therefore, we are really discussing not what might be called desirable, but that which is a fact. I am free to say that this discussion to me is the consideration of how we shall regulate an evil that is among us, but which we are not yet ready to abandon entirely.

By this preface I wish it understood that I am not favoring degrees, but some rational way of conferring them.

The first point to be made in the discussion, and apparently the chief storm center thus far, is in connection with the bachelor's degree. The old contests to which President Jordan referred in his

opening remarks, in which he and I were concerned, had chiefly to do with the position that in the splitting of courses of study the splitting of the bachelor's degree became an absurdity. The compromise proposition suggested by President Van Hise is exactly the same that was used at that time in reference to what was called the bachelor of sciences. There is the same difficulty in determining what is culture. I have come to wince at the use of that term in discussions concerning education. The attempt to differentiate cultural and non-cultural studies has always ended in confusion. It is not so much a distinction between subjects as between teachers, and this distinction can not be formulated. Any subject or any set of subjects leading to any definite useful end in the hands of a real teacher will result in that stage of advancement, that intellectual status, which the bachelor's degree marks. My claim is that if work in engineering, for example, does not result in such intellectual growth as deserves the bachelor's degree it should be stimulated in that direction. In other words, I can not see how any definite distinctions can be made in the undergraduate period of intellectual development. It is our habit to abolish all distinctions later, and the logic of the situation seems to show that we are not describing kinds of training, but are marking distinct steps in progress.

The only other reason I should have for abandoning the distinctive term 'science' in connection with the bachelor's degree is out of respect for science itself. The amount of science to be obtained in any undergraduate course is so insignificant that to make it distinctive of a degree is somewhat absurd, especially if it be implied that the holders of the degree are in any sense trained in science. No such objection can be urged against such use of the word 'art,' as its significance in this connection has long since become conventional. As investigators we know what undergraduate work means, and it is hardly worth differentiating when it comes to degrees. It is only a certain amount of activity during a certain time; and the bachelor's degree came to be agreed upon as a convenient and well-understood statement of a certain stage in intellectual progress. Therefore, I have long been in favor of what has been called a 'blanket degree.'

I believe that the master's degree, that comes next in the order of succession, is to-day probably the worst abused degree. I have had a notion that it might be made, at least in scientific circles, a most useful degree, and I have been so using it. I have called it a 'side-track' degree. There are certain well-intentioned students who do graduate work, but who have not the slightest initiative in the way of investigation. They can acquire and they can retail any amount of second hand information, but they can not do original thinking. For them this degree is useful. In other words, I look at it as a teaching degree, given for what might be called teaching ability as distinguished from the ability to investigate. Many a student who is seeking a doctor's degree may be comfortably side-tracked by the master's degree. Thus, if distinctions are to be made, the master's degree might well be retained as a teaching degree, a degree of position also, but not recognized as a distinct scientific degree involving investigative ability.

The doctor's degree has been mentioned by all the speakers and with unanimity of opinion. The only thing needing emphasis is the great importance of granting it carefully, and only to those who are really investigators. Great violence has been done to this degree, and great discredit brought upon it, simply because there has been no way of side-tracking those who do not deserve it. The definite time requirement

gets us into trouble, for it is not easy to make a student who has fulfilled the residence requirement understand that he has not earned his doctor's degree. Such universal action has been taken to prevent the conferring of honorary degrees of this type that I presume scientific bodies need not emphasize it further. But in certain quarters there is still prevalent the correspondence method, by which the student is exempt from residence or scientific work of any type. It is baldly a reading degree, with an essay based upon the reading.

The chairman has suggested a subject that seems to me well worth consideration. We know that there are tremendous differences in the subsequent history of those who have received the doctor's degree, but there has been no method of differentiating them. I do not know how large a percentage of those who actually achieve the doctor's degree are never heard from afterwards. There ought to be a distinction between these still-born doctors and those who continue to live. I can not propose any method, but the chairman has suggested that Sc.D. might be reserved for this purpose and conferred upon those who have continued to investigate and have become real members of the scientific fraternity. Of course, one may say that these men are known already, but we are considering the subject of conferring degrees, not the subject of their abolition.

THE CHAIRMAN:

Possibly an extract from another letter that I have here may come in rather appropriately here. The gentleman, whose name I will not read in connection with the letter, wrote this in response to a letter that I sent him some time ago:

> * * * My own opinion is that degrees take their value from the man who receives them, and not *vice versa*. I have a Ph.D. as an assistant who is a valuable helper but can't spell the English language in an ordinary letter, and I know several others who have gained the degree by passing the required examinations and writing a thesis, but of whom science will never be a gainer; so the excessive anxiety of some of our friends as to the bestowal of the degree upon those who, though not college men, are known over the world as contributors to knowledge, seems to me rather silly. However, 'many men, many opinions.'

The plan of the executive committee has been to have the gentlemen who have thus far spoken to you this afternoon speak with the knowledge that they were to be called upon for short addresses; but it is considered very desirable that when possible these annual discussions before the American Society of Naturalists shall partake really of the character of discussions, and I trust that in the next fifteen minutes—because we do not need to adjourn before a quarter after four in order to hear Professor Rutherford's lecture—some of the gentlemen who have not come here prepared to speak may favor us with some remarks. The matter is before the society for discussion.

PRESIDENT JORDAN:

I think that all granting of honorary degrees is subject to great abuses. To use it for spectacular purposes is to destroy its dignity. Governors, senators, donors often merit it, but sometimes they turn it into a farce. The honorary degree of LL.D. is only rarely conferred upon professors, the class of men most worthy of such honors, whereas a college president expects to receive it every time he puts on his gown away from home. It is safer to use degrees only as certificates of fruitful residence.

THE CHAIRMAN:

I think that possibly before allowing other speakers to claim the floor, I may read extracts from another letter, the signature of which I will not read, but it is particularly pertinent to the subject. This gentleman says:

> Your letter makes me wish that I could go to St. Louis, for it is a good work, that of trying to lessen the abuse of honorary degrees. * * * Every learned man, be he scientist or humanitarian, should insist on all occasions that honorary degrees should be given only for academic distinction, and never be given under any circumstances whatever to a politician, a soldier or a business man (as such). * * * has sinned grievously (along with the rest) in this matter, and she should be publicly and severely blamed (along with the rest) for debasing her degrees in this manner. * * *

I trust that others who are here, whether members of the society or not, will now take part in the discussion.

PROFESSOR BURRILL:

I suppose if this matter could be settled for ourselves here this afternoon it would be very easy. I have a suspicion, however, that whatever we say or do here will not wholly settle the matter outside. It seems to me that the evident tendency of late has been to differentiate degrees along the lines suggested by President Van Hise. It seems to me that already in a great many of the leading institutions the precedent exists, as suggested by President Jordan, that would permit the degree of B.S. to be accorded for a course in applied scientific work; then, we might well enough have the A.B. degree for all of the courses not tending directly towards a professional pursuit. The degree of bachelor of science possibly may not be the proper one for those taking an engineering course, a course in agriculture, etc.; but that seems to be the one that has been pretty generally adopted for that purpose. In the University of Illinois the matter had been discussed some years ago, and lately it has been revived. The degree of bachelor of science was given to students who had taken major work in any science. Now the degree of A.B. is given to all students except those that take courses in engineering, in agriculture and in the new school of commerce. The last has not been settled. I take it, however, that the degree of A.B. will be used there.

There is another thing, however. Whether it is settled thus or in any other manner that seems to be satisfactory, no person taking a course in civil engineering would care for the A.B. degree compared with the degree of C.E. His work is shown pretty well by that degree, the degree of civil engineer, and though they are not so well established, the degrees of mechanical engineer and electrical engineer follow in the same line. Then there is the difficulty about the candidates in architecture. There are several very prominent architectural schools in our country in which students prepare themselves directly for the profession. They confer the degree of B.S. or B.Arch., followed by M.Arch., and finally perhaps by D.Arch.

These professional degrees are given either immediately at the end of the course of four years, or after some further course of study. If I may quote again the institution with which I am most familiar, the degree of bachelor of science is given at the end of four years in the courses of engineering, and then after a further year's work, usually directly following in the line of the specialty—really professional work —the C.E. or M.E. or M.Arch. degree is given. Something like this, I think, must be done; this terminal degree—perhaps we may call it master's degree—must be specialized, whether or not we differentiate the bachelor degree. I am of the opinion, as I say, that the trend of the country, of the institutions, is in favor of making this distinction.

THE CHAIRMAN:

Are there other speakers? If not, the time for adjournment is rapidly approaching. Before adjourning the meeting I should like to say that as Professor Bur-

rill has pointed out, if we were met together this afternoon to settle this business for ourselves, we probably could so settle it, though we are not likely to settle it for the world at large. But one feature of the Naturalists' discussions has been, as I have watched the discussions, that the members of the society get together to consider in a particularly interested spirit matters which they do not propose to settle, but from the analysis of which they hope that a current of thought may be started which will ultimately result in good. For that reason we have had speakers this afternoon who are representative of geology, zoology, botany and psychology, and who are representative of the country from the Atlantic to the Pacific. I think that we may congratulate ourselves that, although the audience that has listened this afternoon has not been large, the discussion may be brought, perhaps, before a larger audience, and will perhaps start a current of thought in a useful way that will in time contribute to a solution of the problem.

I am going to read one more letter, again without the signature, but a letter from one of the strongest executives of one of the strongest universities in the country:

I wish very much that I were able to cooperate in the discussion which you propose. Unfortunately, my presence is out of the question, on account of an important previous engagement for the very day which you name; and I am not yet quite ready to send any brief formulation of my views on the degree question. I do not believe that the time is quite ripe for such radical measures as I have in mind; and I would rather that those who think that they can do some good by moderate reforms should have every chance to make their experiments unimpeded by destructive criticism. If those who believe that conservative reform is possible can prove their case I shall be very glad. I should wish * * * to be in a position to cooperate with them on any measures which might give promise of reform. Then if reform measures fail the radicals will have a clear field.

The meeting was then declared adjourned.

SCIENTIFIC BOOKS.

Wilhelm Ostwald: Von PAUL WALDEN.

IT is well known that in December last the twenty-fifth anniversary of the doctorate of Ostwald was celebrated in Leipzig. On this occasion a 'Jubelband,' being the *forty-sixth* volume of the *Zeitschrift für physikalische Chemie,* and containing original papers from thirty-four of Ostwald's former students, was presented to him. The 'Jubelband' contained a brief sketch of Ostwald's life and work by van't Hoff, but the book under review deals with both in a much fuller manner.

Walden discusses the life of Ostwald in five periods: 'The Youth in Riga, 1853–1871'; 'The Student in Dorpat, 1872–1875'; 'The Teacher in Dorpat, 1875–1881'; 'The Professor in Riga, 1881–1887'; 'The Professor in Leipzig, 1887 up to the present.'

Ostwald does not seem to have been a marked success as a gymnasium student, and not to have taken his work in a really serious manner until he came to Dorpat. His first scientific publication, which appeared in 1875, shows the bent of his mind at the early age of twenty-two. It bore the title, 'On the Chemical Mass Action of Water.' This was soon followed by his 'Volume Chemical Studies,' which are now recognized to be works of real permanent value.

That tremendous activity and power to work, which is possessed by Ostwald to an unusual degree, began to manifest itself during the Riga period. It was during this period that the first edition of the great *Lehrbuch der Allgemeinen Chemie* appeared—the book which led to the organization of the modern school of physical chemistry. It was in Riga also that the *Zeitschrift für physikalische Chemie* was founded. This was to be the official organ of the new physical chemistry which was just being organized, and has probably contributed more to the development of this branch of science than all other publications, in that it brought together in one place

the various lines of work which constituted the new science.

This, however, is all introductory to Ostwald's greatest work. In 1887 he was called to Leipzig to the chair of physical chemistry just vacated by Gustav Wiedemann. To him as director of 'Des zweiten chemischen Laboratoriums' students came from all parts of the world. Through these, and with his own hands, an enormous amount of work was done. These investigations, which were published, when completed, in the *Zeitschrift,* have since been collected and comprise several large volumes. This large amount of work was done under very unfavorable conditions. A small laboratory, poorly lighted and poorly equipped with apparatus and conveniences, may be said to describe fairly the old laboratory of Ostwald in Leipzig.

The cosmopolitan character of the Leipzig laboratory in the nineties, when it was the good fortune of the writer to have studied with Ostwald, is shown by the fact that of the students who were following physical chemistry as their major subject, the following nationalities were represented: Germany, America, Canada, England, Scotland, Belgium and Russia. Indeed, there were more Americans working with Ostwald at that time than there were of any other nationality, including Germans.

This condition of things is all changed now. The fame of Ostwald as investigator and teacher drew such a large number of students that the old quarters became entirely inadequate. A fine, new Physikalisch-chemisches Institut has been built for Ostwald, and this has now become the home of the 'Leipzig School' of physical chemistry.

The most striking characteristics of Ostwald are his untiring industry, his fertility in ideas and his absolute unselfishness. As an illustration of his power of work, Walden points out that his collected works number already more than 16,000 pages, and in addition to this he has directed probably more than one hundred investigations; has edited the *Zeitschrift,* which is now in its forty-eighth volume, and has founded the *Annalen der Philosophie.*

As illustrating Ostwald's power to work, the writer recalls returning to Leipzig with Ostwald from Berlin in 1894, when van't Hoff delivered his now famous '94' lecture before the Berlin Chemical Society. It was between two and three in the morning when Leipzig was reached. We learned next morning that Ostwald had not retired on returning home, but had spent the remainder of the night in developing some idea that had occurred to him during the journey.

The fertility of Ostwald's mind in new ideas can not have failed to impress any one who had been with him even for a short period, and also the unusual freedom with which suggestions, often of very great importance, were made to any one who had the desire and ability to work them out in the laboratory. And when the work was done the student was told to publish the investigation as if the whole was his own. The result is that a large part of the work done in Ostwald's laboratory does not bear his name, although the original suggestion came from him, and every stage of the investigation was under his daily scrutiny.

All in all, it is difficult to overestimate what Ostwald has already done for chemical science. He is the organizer of the modern school of physical chemistry. But he has gone much farther and shown how the generalizations of the new physical chemistry can be applied to general inorganic chemistry, by both the investigator and the teacher. It is not too much to say that he has inaugurated a new day into the field of general chemistry.

Walden concludes his interesting life of this great man by calling attention to Ostwald's love of art; not as an admirer of finished pictures in a gallery, but as a painter of them. Indeed, one of Ostwald's own pastels is reproduced in Walden's book.

It is interesting to learn not only of the serious work of a leader in natural science, but also how he spends his leisure. In Ostwald we have the love of the scientifically exact, combined with that of the purely beautiful in nature.

Harry C. Jones.

Lehrbuch der Mineralogie. Von MAX BAUER, Zweite, Vollig Neubearbeitete Auflage, 1904. Stuttgart, E. Schweizerbartsche Verlagshandlung (E. Nagele). 1904. Pp. xii, Fig. 670.

A second edition has been issued of Dr. Max Bauer's 'Lehrbuch der Mineralogie,' forming one of the most important works in this department of science that has appeared in the German language. It is printed in large clear type upon good paper, with 670 illustrations, and is exceedingly comprehensive and thorough, not only in dealing with the crystallographic, optical and physical features, but in its account of localities and of new species, which are brought absolutely up to date. Dr. Bauer's position as director of the Mineralogical Institute of Marburg, and his long editorship of the *Jahrbuch für Mineralogie und Geologie,* have given him unusual facilities in the preparation of so important a work, and his well known reputation for thoroughness is an assurance as to its being a complete exposition of the subject. It will form an essential addition to every mineralogical library. G. F. K.

SCIENTIFIC JOURNALS AND ARTICLES.

THE May number of *The Journal of Nervous and Mental Disease* contains the following articles:

'The Central Localization of the Sensory Tract,' by H. H. Hoppe. It contains a full summary of recent anatomical and pathological work on the central localization of sensory functions. 'Two Tumors of the Brain' are reported on by Dr. T. M. McKennan, and Dr. Smith Ely Jelliffe presents a statistical summary of the work of the neurological clinic of Dr. M. Allen Starr for 1903. He shows that in 16 years 31,600 patients have been treated for nervous disease and that about 4 per cent. of all diseases are of the nervous system. 'Two Cases of Meningeal Tumor' are described by Dr. A. C. Brush. These were treated by ligature of the meningeal vessels. 'The Influence of Fever in the Pain of Locomotor Ataxia' is discussed by Dr. C. W. Burr. This number also contains accounts of the meetings of the Philadelphia and New York Neurological Societies, and its regular series of abstracts from the leading neurological journals, *Revue Neurologique, Neurologisches Centralblatt, Deutsche Zeitschrift für Nervenheilkunde, Monatschrift für Psychiatrie und Neurologie* and *Jahrbücher für Psychiatrie und Neurologie* being noted in this number.

CONTENTS of the *Journal of Comparative Neurology and Psychology* for April:

O. P. JENKINS and A. J. CARLSON: 'Physiological Evidence of the Fluidity of the Conducting Substance in the Pedal Nerves of the Slug, *Ariolimax columbianus.*'

C. W. PRENTISS: 'The Nervous Structures in the Palate of the Frog: The Peripheral Networks and the Nature of their Cells and Fibers.'

C. L. HERRICK: 'The Beginnings of Social Reaction in Man and Lower Animals.'

ROBERT M. YERKES: 'Inhibition and Reinforcement of Reaction in the Frog, *Rana clamitans.*'

RAYMOND PEARL: 'On the Behavior and Reactions of *Limulus* in Early Stages of its Development.'

Editorial.

G. E. COGHILL: A Critical Digest of Recent Studies on the Finer Structures of the Nerve Cell.

Literary Notices.

SOCIETIES AND ACADEMIES.

THE BOTANICAL SOCIETY OF WASHINGTON.

THE April meeting of the society was held Saturday evening, April 23, at the Portner Hotel. Mr. David G. Fairchild acted as chairman of the program. After the regular review of literature Dr. George T. Moore, of the Department of Agriculture, spoke on the subject, 'A Method for the Destruction of Algæ and Pathogenic Bacteria in Water Supplies.' The speaker mentioned briefly the history of some of the serious difficulties that have been experienced by the water departments of many cities as a result of contamination of the reservoirs by algæ of one sort or another. He said that he had received numerous complaints from each state of the union, showing that the trouble is general. Its seriousness in many cases is shown by the fact that controlling engineers have in some cases recommended that supplies representing an investment of several million dollars be

abandoned, simply on account of the continued trouble from algæ. The direct result of the presence of algæ in serious cases is that the water acquires a very disagreeable odor and taste which may resemble that of decaying wood or has what is described as a 'fishy' smell and taste. Often this odor and this taste are not due to the decomposition of the plants but are caused by small drops of oil secreted by certain of the algæ.

Up to the present time no practicable remedy has been found for this trouble which is capable of general application. Double filtration, covering the reservoir, the removal of all organic matter and similar expedients have all been tried, and in some cases proved nearly or quite efficient, but such means are usually too expensive or for some other reason are impracticable. It has been shown by experiment, however, that it is quite feasible to treat infected reservoirs with copper sulphate in such quantities as to give a solution varying from one part in a million down to one part in 500 million. The former strength is not considered harmful even as a constant beverage, and the latter dilution appears to be effective in disposing of most algæ under ordinary conditions. In water containing any appreciable amount of lime or organic matter, the copper is soon precipitated out, so that the danger of harmful overdosing is still further prevented.

The speaker deprecated the extravagant statements that have recently been made in the daily papers regarding the efficacy of this copper treatment in ridding water supplies of certain pathogenic bacteria, such as the germs of typhoid and cholera. In his opinion the present indications are that where no other remedies can be applied to prevent or remove bacterial infection this may be accomplished by treatment with copper. It is in no way designed to replace slow sand or other effective filtration methods now in use, but it is believed may be of some service where such systems are not installed.

Mr. L. L. Harter, of the Department of Agriculture, then spoke on the subject, 'Varietal Differences in Resistance to Toxic Salts.' The speaker outlined some experiments that he has recently undertaken with a view of determining whether or not varieties of the same species differ in their resistance to toxic salt solution. He has conducted the work with wheat varieties obtained from various sources and which show great diversity of climatic and soil conditions.

He found that it required a solution of sodium carbonate three times as concentrated to kill a Kansas or Russian variety as it did one from Michigan. The limits in sodium chloride varied from .045 to .055 of a normal solution, and of sodium bicarbonate from .025 to .03. He further showed that the Michigan and Russian varieties are two and one half and two times respectively more resistant in magnesium chloride than one obtained from Turkestan. Almost as great a variation was obtained with the Michigan and Kansas varieties over the one from Turkestan, requiring in both cases twice the concentration of magnesium sulphate to kill the root tips.

Carl S. Scofield,
Recording Secretary.

THE TORREY BOTANICAL CLUB.

The meeting of Tuesday, March 8, 1904, was held at the College of Pharmacy, with Vice-president Rusby in the chair; there were seventeen persons present. The minutes of the preceding meeting were read and approved.

The first paper on the scientific program was by Professor Francis E. Lloyd on 'Recent Investigations on the Pollen-tube,' and was an interesting exposition of the parallel results of Longo's investigations on the behavior of the pollen-tube in Cucurbitaceæ and Professor Lloyd's work on Rubiaceæ.

Longo finds that in *Cucurbita Pepo* L., the ovary is provided with a special conductive tissue reaching to the neck of the flask-shaped nucellus by means of which the pollen-tube follows a completely intercellular course from stigma to embryo-sac. In other species of *Cucurbita* and in *Citrullus vulgaris* the neck of the nucellus is not long enough to reach to the conductive tissue, so that for a short distance the tube must move through a cavity. On reaching the neck of the nucellus, the pollen-tube forms a bulla that produces lateral outgrowths which Longo believes are for the

purpose of reaching out after food materials, as their size seems to depend on the amount of starch present. This view is rendered somewhat questionable by the phenomena observed by Wylie in *Elodea*, where pollen-tubes may produce similar 'cystoids' in the free space of the locule, but never produce them in the tissues where food substances must be more abundant.

Longo supports his conclusion that the intercellular course of the pollen-tube is followed not because of inability to grow in open space, by showing that pollen-tubes may be produced in moist air from such normally endotropic forms as *Humulus Lupulus* L., *Picea excelsa*, etc. He interprets chalazogamy as a physiological fact having bearing on phylogeny. In plants having endotropic pollen-tubes, he considers the direction of their growth to be determined chemotactically.

The main points in Professor Lloyd's independent conclusions from work on Rubiaceæ are: (1) The form of cells in the conductive tissue does not determine the course of the pollen-tube, for in *Richardsonia* and *Diodia teres* the cells are elongated at right angles to the path of the tube. He believes the chemotactic stimulus which determines the direction to be differentially distributed from the egg cell. (2) The ectotropic or endotropic behavior of the pollen-tube is a physiological character.

The second paper of the evening, by Mr. Edward W. Berry, was entitled 'Some Monotypic Genera of the Eastern United States and their Ancestors.' The phylogeny of *Liriodendron* was briefly sketched from its first appearance as a narrow simple-leaved form in the mid-Cretaceous of the Atlantic coastal plain, its spread to Europe and Asia, its development into large lobate leaved forms, and its final extinction except for the existing species of eastern North America and a waning variety in eastern Asia. Drawings of all the fossil species were shown, and numerous blue-prints of the leaves of the existing species, showing their parallelism and range of variation.

Sassafras was the second genus considered. It was pointed out that while the described fossil species were numerous, many of them are not allied to *Sassafras*. The species which were considered as positively identified were discussed, as well as the peculiar characters of the leaves of the existing species, both ancient and modern forms being abundantly illustrated.

The third genus discussed was *Comptonia*. Its former range and development were described and drawings of a number of the species were shown.

All three genera were considered to have taken their origin from simple-leaved ancestors which flourished during the closing days of the lower cretaceous, and to have originated in America, becoming dominant and widespread in pre-glacial times, finally becoming restricted to their present habitats chiefly through the agency of the glacial conditions of the Pleistocene period.

The paper was discussed by Professors Rusby, Underwood and Lloyd and Dr. Howe.

TRACY E. HAZEN,
Secretary pro tem.

THE NEW YORK ACADEMY OF SCIENCES.

SECTION OF ASTRONOMY, PHYSICS AND CHEMISTRY.

THE regular meeting of the section was held on April 4, at the American Museum of Natural History. The program consisted of three papers, abstracts of which are as follows:

The Variation of Latitude at New York City: Part 2, Variation of Latitude and Constant of Aberration: J. K. REES, HAROLD JACOBY and HERMAN S. DAVIS.

The results of seven years' continuous observations for a study of latitude variation and the aberration of light are contained in the present paper, which will appear as the second and last part of Vol. 1, in the academy's series of *Memoirs*. To that publication the reader is referred for complete details and results; it is not possible here to do more than mention very briefly the plan of the work, and to state the fact of its completion.

The simultaneous and continuous observation of the same stars at stations situated on a single parallel of latitude, but separated widely in longitude, has long been recognized as the best method of attacking the problem

under consideration; the first actual practical application of the method is the one treated in the present paper. The other participating observatory is the one at Capodimonte, near Naples, where simultaneous observations were made by Professor Fergola and his associates.

The New York and Naples work was continued until a similar, but a more elaborate, plan was put in operation by the International Geodetic Association, which includes all civilized governments. This plan involved the establishment of four suitable special latitude stations, and rendered further work at New York and Naples unnecessary.

Energy Liberated by Thorium: George B. Pegram and Harold W. Webb.

The method used in this investigation of the energy liberated by thorium due to its radioactivity was to measure the difference between the temperature of three kilograms of thorium oxide, enclosed in a Dewar bulb, and that of a surrounding ice-bath, by means of a set of iron-constantin thermo-electric couples. Uniformity of temperature in the bath was secured by means of a rotating stirrer and careful heat insulation. The thorium oxide was cooled, so that its initial temperature was below that of the surrounding bath. Readings were taken at frequent intervals, and after several days the difference of temperature became constant, with the oxide .04° warmer than the bath. Several such series of observations were made. From the rate of change of temperature and from an approximate calculation of the heat capacity of bulb and oxide, a tentative value of the heat liberated was found; 8×10^{-5} gram-calories per gram of thorium oxide per hour (.93 ergs per gram per second), or 9×10^{-5} gram-calories per gram of pure thorium per hour. Further investigation is being made to determine these values more accurately.

Note on a Tribophosphoroscope, and the Duration and Spectrum of Tribophosphorescent Light: Wallace Goold Levison.

Discs of thick pasteboard about 15 cm. in diameter are evenly sanded on one or both sides on a coating of liquid glue with the materials to be examined in powder, narrow bands being sufficient and only small quantities of the materials required.

The disc selected is then rotated at a known and usually moderate speed (twelve revolutions per second, for example) by any convenient mechanism, such as an ordinary rotator used for illustrating the recomposition of light.

A point or brush of wire or other material, or a piece of the same material with which the disc is coated, being pressed against the sanded surface, produces a trail of light which extends from the point of contact in an arc more or less around the disc; varying in color with different materials and in length with the speed, and is maintained for some time unless the material is rubbed off by extreme friction. A grindstone or corundum wheel may often be used to advantage with hard substances as a substitute for the disc, since a specimen held against it soon coats it with a trace of the material which shows its luminous trail beautifully.

By means of the device described the intensity of the light may be determined with a photometer, its duration from the length of the trail, and its spectrum delineated with a spectroscope.

The following approximate, tentative results of the examination of a few minerals are given to illustrate its applicability.

1. Sphalerite (1) from Utah. Light yellow concretions in gray massive sphalerite. Visible trails are produced of respectively increasing brilliancy and length with the tip of the finger; a wooden match; the finger nail; a brass wire brush; and a steel wire brush, or point; of a yellow orange color, visible, with the latter, at a distance of several yards and extending about one quarter around the disc at the above speed. Hence, the duration is about 0.02 s. The spectrum is short, extending from about the line *C* to the line *E* and embracing some red, orange, yellow, yellow-green and green. (2) From another locality very similar to the above in character, and afforded like results. (3) Of several dark colored sphalerites some showed a little light

at the point of contact of the brush, but no trail.

2. Quartz. (Sandpaper disc or grindstone.) No light from brushes (except incandescent sparks from hard steel). A piece of quartz, however, gives a bright yellow light, and if of rock crystal is luminous within by internal reflection. Very short trail and duration.

3. Corundum. (Emery paper disc or corundum wheel.) No light from brushes (except as above). A piece of ruby or ruby corundum against the corundum wheel or a grindstone evokes a brilliant crimson light and short trail and is luminous within by internal reflection. Duration about 0.005 s.; a piece of emery against a corundum wheel gives a like trail but is not itself luminous.

4. Pectolite, Woodcliff, N. J. Wire brush. Light greenish-blue trail only medium bright but extending completely around the disc. Duration over 0.08 s.

5. Limestone, Hellfire Rock, Utah. Feeble greenish-blue but similarly long trail. Duration over 0.08 s.

6. Willemite. (1) Hard yellow-green gem material, Franklin, N. J. Short greenish-yellow trail. Duration very short. (2) Opaque, massive green variety. Feeble short green trail. Duration about 0.02 s. Best obtained with a spectrum pressed against a corundum wheel or grindstone. Various specimens give somewhat different effects. (3) Pink or brown variety. Longer and brighter green trail. Duration about 0.03 s.

7. Chlorophane. (1) Violet from Trumbull, Conn. Bright green and very long trail; best obtained by friction of a specimen against a grindstone or corundum wheel or a disc coated with the same material. Duration over 0.40 s. Spectrum broad band in the yellow-green and green. (2) Green from Amelia Co. Courthouse, Va. Trail similar but brighter; spectrum similar. (3) Red from Haddan Neck, Conn. Trail similar.

In the discussion of the paper that followed Dr. George F. Kunz stated that Professor Baskerville and himself had under examination a zinc-blende from Utah, the natural mineral varying in color from yellow to fawn and to pale brown. This was the most intense tribo-luminescent substance that they had yet investigated. Two bits one fourth the size of a pea, if pressed together lightly with the fingers, caused a brilliant yellow green light to glow as long as the pressure lasted; and it also possessed the property of becoming radio-responsive to the beta and gamma rays of radium; that it was the first natural zinc-blende they had examined that showed this remarkable property.

Mr. W. J. Hammer showed a sample of artificial blende made by Mr. W. S. Andrews, of Schenectady, N. Y., which gave very strong tribo-luminescence.

C. C. TROWBRIDGE,
Secretary.

THE ACADEMY OF SCIENCE AND ART OF PITTSBURG. SECTION OF BIOLOGY.

THE regular monthly meeting of the section was held on February 2 in the lecture hall of the Carnegie Institute. Three topics were presented. The first paper was offered by Mr. W. E. Clyde Todd, on 'The Birds of Erie and Presque Isle, Erie County, Pa.' This paper is based on his personal observations during the season of 1900, supplemented by extensive field notes made by local observers, and published records.

The locality in question is considered by the author as the most favorable in the entire state for the study of water-birds. Two hundred and thirty-seven species are recorded. A full account is given of the physical features and climatic conditions of the lake shore plain, and after a careful study of the avifauna of the region Mr. Todd reaches the conclusion that it should be included in the Alleghenian fauna.

Dr. A. E. Ortmann followed with a paper on 'The Cosmopolitan Character of the Deep-Sea Fauna,' stating that a small collection of deep-sea schizopods from the Hawaiian Islands, recently received at the Carnegie Museum, has furnished a few new cases which show very wide horizontal distribution. Species found hitherto only in the Atlantic Ocean are recorded for the first time from the Pacific, a circumstance which strongly suggests their

cosmopolitan distribution. This fact is not, however, a new discovery, as similar cases have been observed before, but it is considered worth while to carefully record all these cases, since it has been doubted whether a world-wide distribution is a prominent characteristic of the deep-sea fauna.

Although it is not contended that there are not cases of a more restricted distribution among abysmal animals, yet we must recognize cosmopolitan distribution as a remarkable feature of the deep-sea fauna, inasmuch as we have a very good explanation of this condition of affairs, in the fact that climatic differences are not present in the deep sea, as its temperature is uniformly cold.

Frederic S. Webster closed the meeting with his topic 'The Smallest Carnivore,' exhibiting four of the seven known specimens of this rare and diminutive weasel, *Putorius allegheniensis*. One of the mounted specimens was taken but a few days before the meeting of the section, and is very interesting, as it proved to be an adult male, and the first one of this sex secured. It is beautifully dressed in a dense winter coat of clear unstained white, excepting a few rather pale brownish markings on the crown and occipital region, and a very narrow dorsal line, about the length of the sacrum, and another small spot on the heel of the right leg. A few dark brownish hairs tip the short delicate tail.

Three important features were pointed out, *i. e.*, that the well-known disproportion in size existing between the sexes of other species of weasels is not a marked characteristic of this little-known species, nor does the indistinct brown of the tail seem to indicate that this member is furnished with the usual black of the other species.

Another interesting feature is noticeable in the dentition, and as this peculiarity is present in three of the specimens (the fourth specimen has the incisors of the mandible injured) we are inclined to believe that it is a constant feature of this species.

In all the skulls of *Putorius noveboracensis* in the collections of the Carnegie Museum the mandibular incisors are placed more or less in a continuous line, and can be readily counted when the jaws are closed, but in *Putorius allegheniensis* the second incisors are posterior, being placed *quite* back of the first, and third, and are consequently neatly hidden away behind these teeth when the jaws are closed, giving the impression that there are but four incisors present in the mandible instead of six.

A second specimen, also mounted, is in winter coat, but considerable brown is spread here and there over the dorsal region. But little brown or black tips the tail.

A third specimen was that of a mimmied animal in summer pelage. The throat and chest are irregularly marked with white; the abdomen has the same uniform brown of the back.

The fourth specimen (a skin) had considerable white on the under parts; but is not evenly distributed.

It would not be surprising if, when a specimen in full summer pelage is obtained, we should find that this species differs from the other weasels in wearing throughout a uniform coat of brown in summer.

Six of the seven specimens taken have been found in Pennsylvania. The male specimen was caught at Pravo, Jefferson County, Ohio, in a box trap, by a country lad, and he, thinking it a common 'varmint,' promptly despatched it by placing the trap in a trout stream.

Frederic S. Webster,
Secretary-Treasurer.

The Society for Experimental Biology and Medicine.

The sixth regular meeting of the Society for Experimental Biology and Medicine was held on the evening of April 20, in the bacteriological laboratory of the department of pathology of Columbia University, at the College of Physicians and Surgeons. Dr. S. J. Meltzer presided.

Members Present.—Burton-Opitz, Calkins, Gies, Hiss, Hunt, Jackson, Lee, Levene, Lusk, Meltzer, Murlin, Norris, Park, Richards, Wadsworth, Wallace, Wilson, Yatsu.

Members Elected.—J. J. Abel, E. G. Conklin, A. R. Cushny, C. B. Davenport, W. H.

Howell, L. B. Mendel, T. H. Morgan, F. G. Novy, W. T. Porter, L. B. Stookey, W. H. Welch.

Constitutional Amendment.—The following amendment was added to the constitution by unanimous vote: "Each non-resident member shall be required to present in person, at least once every two years, a communication containing the results of an *experimental* investigation, or to send to the president, within that time, such a communication for presentation at a regular meeting of the society."

Eligibility to Membership.—Many inquiries regarding admission to membership in the society have recently been addressed to the secretary. It seems desirable to state publicly that only *active investigators* in biology or medicine are eligible to membership. The constitution of the society provides for *automatic forfeiture of membership* by any member who may cease to be an 'active investigator, *by experimental methods,* in biology or medicine.' Visitors are welcomed to the meetings.

Abstracts of reports of original investigations:*

On the Secretion of Human Bile: P. A. LEVENE, W. G. MELVIN and B. MICHAILOWSKI.

The bile was obtained from a patient with a biliary fistula. The patient had been operated upon for gall stones, and was in comparatively good health at the time of the experiment.

Diet and Dosage.	Volume—24 hrs., c.c.	Total Solids, %	Organic Matter, %	Ash %
Mixed diet	780	1.57	0.76	0.82
Animal diet	785	1.68	0.60	1.08
Milk diet	845	1.61	0.56	1.05
Vegetable diet	835	1.64	0.80	0.84
Sodium carbonate	461	1.62	0.71	0.92
Hydrochloric acid	461	1.53	1.08	0.45
Calcium chloride	687	1.63	0.56	1.08
Sodium salicylate	642	1.40	0.42	0.98
Methylene blue	864	1.58	0.54	1.04

Attention was directed to (1) the influence of diet on the quantity of bile secreted per twenty-four hours, (2) the permeability of the biliary ducts for certain substances like methylene blue and sodium salicylate, (3) the influence of these substances and of some salts and acids on the secretion, and (4) on the nature of the so-called 'bile mucin.'

The quantities of bile secreted under different conditions, together with other data, are briefly summarized above.

For methylene blue and sodium salicylate the bile ducts proved less permeable than the kidneys. There was observed a marked increase in secretion after subcutaneous injections of methylene blue. The 'mucin' was found to be a phosphorized proteid, but no purin bases could be detected in its molecule.

Experiments with Certain Nitriles and their Antidotes: REID HUNT.

Experiments (carried out in the laboratory of Professor Ehrlich) on the toxicity of a number of nitriles, and the antidotal action of certain sulphur compounds towards them, were described. Most of the nitriles studied are poisonous in virtue of the HCN which is split off in the body; in the case of some of the nitriles of the aromatic series and of certain amino nitriles, the molecules themselves seem to be poisonous. Although each of nearly all of the compounds studied is capable of splitting off one molecule of HCN, it was found that the toxicity of the various compounds differed greatly. The toxicity depends in general upon the ease with which the HCN is split off; in some cases this seems to bear a relation to the ease with which the residue united to the CN group is oxidized in the body. Benzonitrile, containing the group C_6H_5, which is oxidized with difficulty in the body, is scarcely more poisonous than phenol. Acetonitrile, also containing a group, CH_3, which is oxidized with difficulty, is also but slightly toxic. Propionitrile and formaldehydecyanhydrin, which contain easily oxidizable groups, C_2H_5 and CH_2OH, are very poisonous.

The toxicity of the molecules of a few nitriles is greater than that of HCN itself, although the latter was the only toxic agent involved. Thus, the molecule of chloralcyanhydrin, $CCl_3CH(OH)CN$, is nearly twice as toxic as that of HCN. The probable explanation of this is that the chloral residue with

* The authors of the reports have furnished the abstracts. The secretary has made only a few abbreviations and minor alterations in them.

which the CN is in combination causes this compound to be distributed especially to the central nervous system; the HCN is thus split off in greater concentration in these important organs than is the case after the administration of a compound which is distributed more uniformly to important and unimportant organs. Through the application of this principle it may be possible to modify the distribution in the body of a remedial agent, so that the active principle may be present in especially great concentration in the organs which it is desired to affect. It was suggested that the powerful action of nitroglycerine upon the blood vessels may be explained on a similar hypothesis. The view of Hay, that the dilatation of the blood vessels caused by nitroglycerine is due to the formation in the organism of nitrites from this body has been generally accepted, although the objection has been made that it requires two hundred times more sodium nitrite than nitroglycerine to produce a given effect. This criticism may be met by the hypothesis that the glycerine residue of the nitroglycerine causes this compound to be distributed especially to the arterial walls, so that the nitrite will be formed in greatest concentration at the point where it exerts its action.

The work of Heymans and Masoin on the antagonistic action of sodium thiosulphate towards certain nitriles was extended to many new cyanogen compounds. In addition to the thiosulphate, several other compounds, containing a sulphur atom which is easily split off, were tested (the sulphur unites in the body to form a little poisonous sulphocyanate). The most efficient of these new sulphur compounds were thialdin, carbothialdin and potassium xanthogenate. Great differences in the extent of the antidotal action of these bodies towards the various nitriles were noted. Thus, thialdin protected against nitriles towards which potassium xanthogenate was without action; towards other nitriles potassium xanthogenate was the more efficacious. Many of these differences can be easily explained on the hypothesis that the various nitriles and sulphur compounds are differently distributed in the body. Unless both the sulphur compound and the nitrile reach the same cells, and unless the conditions in these cells are favorable for the formation of the sulphocyanate, no neutralization will take place.

Especially interesting are the experiments on the antidotal action of alcohol towards certain nitriles. It was found that small doses of alcohol protected an animal against three to five times the fatal dose of acetonitrile and formaldehydecyanhydrin, and that after otherwise fatal doses of these substances, the animal recovered if small doses of alcohol were given. It was suggested that the explanation for this action may be that, because it is easily oxidized, alcohol consumed the oxygen usually available for the oxidation of the CH_3 and CH_2OH groups of these compounds, and for the consequent liberation of the HCN. Support for this hypothesis was found in the fact that dextrose (another easily oxidizable substance) also protects against acetonitrile.

This seems to be the first case in which alcohol has been clearly shown to have an antidotal action toward a poison. It was suggested that alcohol may have an analogous action in certain pathological conditions in which physicians have long claimed a beneficial result from its use. Toward HCN itself and several other nitriles, alcohol has no antidotal action; in fact, in some cases the toxicity of the nitrile was increased by it.

Toxicity of Certain Quinine Derivatives: Reid Hunt.

In one of the side chains of the quinine molecule there is, according to the commonly accepted view, a vinyl group, $-CH=CH_2$. As the toxicity of many compounds (*e. g.*, neurine and allyl alcohol) is chiefly due to the presence of such a group, experiments were made (in Professor Ehrlich's laboratory) to determine whether this is the case with quinine. A number of derivatives in which the vinyl union was broken by the addition of H (hydroquinine), or of O or OH (oxyhydroquinine), or of H and Cl (hydrochlorquinine), were tested as to their toxicity upon various mammals and certain infusoria. The experiments showed that the presence of the vinyl group in quinine is without special significance as far as toxicity is concerned, the first two of

the new compounds being about as poisonous as quinine itself. The results of the experiments with hydrochlorquinine are of special interest; these showed that the addition of H and Cl decreases the toxicity for mammals while increasing it for infusoria. Thus the amount of hydrochlorquinine required to kill mice was two and a half times as much as that of quinine, while the former substance is distinctly more poisonous to certain infusoria than the latter. It is possible that hydrochlorquinine (or similar compounds) will be found to be more effective than quinine, in the treatment of malaria, and further work along these lines may result in the discovery of quinine derivatives which will be of value in certain diseases, caused by protozoa, in which quinine is of little value. Further experiments are in progress.

Report on the Metabolism of a Case of Diabetes Mellitus: A. R. MANDEL and GRAHAM LUSK.

The case was a young man whose urine contained no albumin, little ammonia, only a small amount of acetone and no β-oxybutyric acid. All these symptoms are said to justify a favorable prognosis. The patient was put on three different diets for three successive periods: Diet I.—Rich cream, oatmeal, meat, eggs, butter; Diet II.—Same as I., with 100 grams of levulose; Diet III.—Rich cream, meat and eggs. The oatmeal was used on account of the favorable results obtained by Von Noorden.

Diet III. was practically a meat-fat diet. Upon this diet the polyuria decreased and the sugar fell from 8 to 4 per cent., both of which phenomena would be favorably interpreted by the clinician. But on calculating the ratio between sugar and nitrogen in the urine (after deducting the sugar fed in the cream) the relation between the two was found to be 3.65 grams of dextrose to 1 gram of nitrogen, as follows:

1904.	Dextrose, grams.	Nitrogen, grams.	D: N.
March 2.....	82.7	23.0	3.60: 1
3.....	87.1	23.8	3.65: 1
4.....100.7		27.5	3.66: 1

It will be noticed that the sugar and nitrogen rise and fall together. The amount of fat fed varied, but did not affect the ratio. The sugar production is therefore parallel to the proteid metabolism. Since 1 gram of urinary nitrogen represents the destruction of 6.25 grams of proteid, we can calculate the sugar production from proteid. This D:N ratio is the same as that obtained in our laboratory in phlorhizinized dogs. It has also been obtained by others in the human subject, but has been falsely interpreted as indicating the production of sugar from fat. It represents the maximum output of sugar from proteid and a complete intolerance for carbohydrate. It is probably the most grievous prognostic sign in diabetes.

A calculation shows that the carbohydrates in the oatmeal and levulose were nearly quantitatively eliminated in the urine when the patient was under the influence of Diets I. and II.

The patient rapidly lost in weight and died in coma five weeks after the completion of the above investigation.

Antihæmolytic Properties of the Serum of Nephrectomized Rabbits: S. J. MELTZER and WILLIAM SALANT.

In studying the properties of the blood of nephrectomized rabbits it was found that bullock's serum, which is distinctly hæmolytic, for normal rabbit's blood, was less so for the red cells of nephrectomized rabbits. It was found, further, that the serum of nephrectomized rabbits contains a distinct antihæmolytic element which is destroyed by heating for an hour at 58° C. On the other hand, the 'washed' red cells of nephrectomized rabbit's blood are at least no more resistant to the hæmolytic influence of bullock's serum than the red cells of normal rabbit's blood.

On the Influence of Suprarenal Extract upon Absorption and Elimination, with Demonstration: S. J. MELTZER and JOHN AUER.

In a series of experiments it was found that a previous intravenous injection of adrenalin will make a rabbit resistant to a surely fatal dose of strychnine. (Such an experiment was demonstrated to the society.) In experiments with subcutaneous injections of fluorescein it was also found that in the animal which had previously received injections of adrenalin the

greenish yellow color of the conjunctiva, mucous membranes and skin appeared much later than in the control animal. Both results might be due to delayed absorption or delayed transudation, or to both. In further studies with subcutaneous injections of fluorescein it was found that the color entered the blood later, and in diminished quantity, in the adrenalin animal than in the control. Among other observations, it was noted that the kidneys of the control animal were more intensely colored than those of the adrenalin animal. The same difference was found when equal quantities of the stain were injected directly into the blood stream. The lesser coloration of the kidney is therefore due to the diminished elimination by the kidneys in the adrenalin-animal. Other related problems are still under consideration. But the reported series of experiments already justify the conclusions that suprarenal extract delays absorption as well as elimination.

The starting point for the investigation was the hypothesis, stated by Dr. Meltzer in another publication, that since capillary endothelia possess irritability and contractility, their pores are surrounded by rings of contractile protoplasm which act like sphincters upon them, thus increasing and decreasing the permeability of the endothelia. The explanation for the observed facts is now offered that suprarenal extract, which causes contraction of the smooth muscle fibers of the arterioles, causes, also, an increase of the contractility of the endothelia, diminishing thereby their permeability and thus reducing their powers of absorption and elimination.

Mendel's Law. E. B. Wilson.

A review of the more important facts in Mendel's observations, together with a statement of some of the deductions to be drawn from them.

William J. Gies,
Secretary.

SCIENCE CLUB, UNIVERSITY OF WISCONSIN.

The seventh meeting of the club for the year 1903–04 was held in the physical lecture room of Science Hall, April 26.

The first paper, by N. M. Fenneman, on 'The Arapahoe Glacier in Colorado' was a description of some recent explorations by the author and investigation of the character of the Arapahoe Glacier. This glacier lies about twenty miles west of Boulder, Colorado, and is about a half mile long and about a half mile wide. It has been only recently that the glacier has been studied scientifically. The glacier follows the type of the North American glaciers.

The second paper, by W. D. Frost, on 'The Antagonism of Certain Saprophytic Bacteria against the Typhoid Bacillus' developed the facts that four very common bacteria produce substances that kill the typhoid germ; that these substances are heat stable but that their efficiency varies directly as the temperature; and that they are alkaline and are neutralized by acids. Mr. Frost's experiments have shown that at the temperature of the ice-chest these substances do not kill the typhoid germs and hence is explained the prevalence of the most severe epidemics of typhoid in winter.

After the foregoing papers were read and discussed the club proceeded to elect the following officers for 1904–5:

President—H. L. Russell.
Vice-President—A. Trowbridge.
Secretary-Treasurer—F. W. Woll.

Victor Lenher,
Secretary.

DISCUSSION AND CORRESPONDENCE.

SHALL WE HAVE TWO GRADES OF COLLEGE PHYSICS?

The writer has examined about twenty catalogues of institutions where technical courses in engineering exist side by side with courses which may be termed general or cultural. Of these only five made any distinction in the manner in which the subject of physics was presented to students in their various departments. Doubtless a more extended investigation of the subject would reveal others, but it is probable that the ratio would not be greatly changed.

I wish in this note to raise the question whether it is not wise to give two courses in general physics in such institutions as have been referred to, the one being adapted to en-

gineering students, and the other to classical, chemical and literary students. Personally I believe it is highly desirable to make this distinction.

The problem of the inequality of student interest and capacity is one that confronts college teachers of physics in an unusual degree. It does not always (and, perhaps, not usually) follow that the poorest students in physics are the poorest in other subjects; it is simply that the charms of physics reveal themselves only to those who are willing to work hard and long over its perplexities. A course in history or civics may appeal to a student who expects to go into business when he leaves college, but optical interference and magnetic hysteresis are likely to appeal only to the specialist.

As a rule these two classes are clearly defined. Students who are expecting to use physics as a foundation for technical branches will master its difficulties as a matter of course; while the other class think themselves aggrieved that they should be burdened with mathematical theories and problems.

There results a very unfortunate state of affairs when these classes of students are reciting in the same division. The question, therefore, arises, Is there not some remedy for the difficulty? And the only possible solution becomes an easy solution if we are ready to answer affirmatively the question propounded in the heading of this article.

Leaving out of consideration the question of ease or difficulty in teaching, does it not seem fitting that physics should be presented to a student who is looking towards civil or electrical engineering, somewhat differently than to one who is preparing for law, theology or business? To be more specific, it seems to the writer that the mathematical treatment of physical subjects is undesirable in cases where the student is not looking forward to further work along this line. It is unfortunate that a subject so delightful under certain conditions should be made the bugbear of the course by insistence upon rigid mathematical applications. For example, Hastings and Beach's textbook, to which I can not pay a higher compliment than to say that I use it each year with about eighty engineering students, is, in my opinion, absolutely unadapted to students in classical, literary or chemical courses.

What is the purpose of the training in physics which these latter students receive? In the first place it develops their reasoning faculties in a very high degree; secondly, it makes (or ought to make) them familiar with the historical development of the various physical theories which are commonly accepted at the present time; thirdly, it gives them an insight into the laws and processes of nature. If these points are well taken, it may be admitted that for the development of logical methods and processes nothing can surpass the applications of mathematics to physics; but such a large amount of similar training must of necessity come from the various mathematical courses usually pursued that the first need not be insisted upon. It is rather the second and third statements of the advantages of physics for general students that appeal to us. And these are very distinct from the purposes of a course for technical students. It would without doubt be a poor technical course which entirely neglected the historical development or other general features of the subject, but, on the whole, the purposes of general and technical courses are diverse. One who is looking forward to the law as a profession ought to know the conditions under which the law of gravitation was discovered, and something of the development of the doctrine of the conservation of energy. But there is no occasion for his mastering, or better, life is too short for him to stop to master, the mathematical development of simple harmonic motion or the kinetic theory of gases.

The fact that so many institutions prescribe the same courses in physics for students in all departments would indicate that there must be good reasons for so doing. This note is written by one who pursues the opposite policy with the hope that some of these reasons may be published in a future number of SCIENCE.

JAMES S. STEVENS.
UNIVERSITY OF MAINE.

COMET *a* 1904.

THIS comet, discovered by Professor W. R. Brooks on the night of April 16, has an orbit

worthy of note. Lick Observatory Bulletin No. 54 gives elliptic elements computed by Messrs. Curtiss and Albrecht. The extraordinarily small eccentricity (0.17733) together with the major axis ($\log a = 0.31970$) at once suggests asteroidal orbits. In fact, so far as size is concerned, the orbit is seen to lie between the orbits of Mars and Jupiter, the comet's perihelion distance being slightly greater than the aphelion distance of Mars. It will also be noticed that the eccentricity is less than that of Mercury's orbit, and, indeed, less than the eccentricities of the orbits of many of the minor planets, including Eros. But the inclination, more than 126,° with consequent retrograde motion, of course sharply distinguishes it from any known planetary orbit.

However disappointing the comet may be in its physical appearance and characteristics, it is to be hoped that a number of observations may be secured and a study of the orbit made, with especial reference to the comet's past and future relations to Mars and Jupiter when in or near its line of nodes.

Ellen Hayes.

Whitin Observatory,
Wellesley, Mass.,
May 4, 1904.

SPECIAL ARTICLES.

THE WATER-SOLUBLE PLANT FOOD OF SOILS.*

Data were given showing the amount of phosphoric acid removed by crops, particularly wheat, at different stages of growth. In the case of wheat it was shown that from one square yard of soil 1,106 grams of dry matter, containing 10.18 grams of phosphoric acid, were secured. Does all of this come from water soluble forms? Reference was made to Hellriegel's exhaustive work, showing that 359 grams of water are required to produce one gram of dry matter in the form of spring wheat. It was found that the quantity of water required to produce 1,106 grams of wheat could dissolve only 1.9 grams of phosphoric acid from the soil upon which the wheat was grown. In determining the water soluble phosphoric acid the quantities of soil and water recommended by Whitney and Cameron in Bulletin No. 22, Division of Soils, U. S. Department of Agriculture, were used. The soil was left in contact with the water for fifteen days.

It was shown that if all the water taken from the soil was in the form of a saturated soil solution by physical action alone only 1.9 grams could have been supplied out of a total of 10.18 grams, in water-soluble forms. The conclusion was reached that over 81 per cent. of the phosphoric acid of the wheat crop was secured from forms insoluble in water. Similar data for oats, peas, corn and flax showed that the water-soluble phosphoric acid was only a minor factor in the food supply of the crops.

Some of the data in Bulletin No. 22 were examined. The experiments by Birner and Lucanus were reviewed, and it was shown that all of the data were not given. Instead of being a normal oat crop, as claimed by Whitney and Cameron, it was shown that Birner and Lucanus secured from three to six times as much organic matter when more plant food than that secured in the well water was supplied. There were abnormal amounts of plant food, particularly nitrates, in the well water; over sixty parts per million were present. This was shown to be more than is found in London sewage. The work of Birner and Lucanus can not be questioned, but the application of their results was shown to be inconsistent. It was noted on one page (10) that 'with the chemical methods then available it was realized that the small amount of plant food contained in a soil extract could not be determined with sufficient accuracy to justify the formation of any definite conclusion,' and then on a subsequent page the results of Birner and Lucanus, obtained in 1863–1866, by such methods, are cited as the only evidence that plants obtain all of their food from water-soluble forms.

The action of plant roots upon limestone is accounted for by Whitney and Cameron by the soil water being charged with carbon dioxide. It has been shown that the same result was secured when most seeds were germi-

* Presented at the St. Louis (1903) meeting of the Society for the Promotion of Agricultural Science.

nated between litmus paper moistened with distilled water. The acid tracings of the roots were distinct, and there were no soil solutions charged with carbon dioxide present.

A critical examination of the data given in Bulletin No. 22 shows that the conclusion is not consistent with the figures. To illustrate: On page 32 it is stated that a wheat field yielding 35 bushels per acre contained 2.49 parts of PO_4 per million parts of air-dry soil. The most liberal calculations show less than five pounds per acre foot of water-soluble phosphoric acid; accepting the data given as correct, a wheat crop of 35 bushels would remove 40 pounds at least of phosphoric acid. In other words, all of the water-soluble phosphoric acid in this soil to a depth of eight feet by pure physical action alone would not supply this crop with food. To assume that all the water-soluble plant food can possibly be utilized to a depth of eight feet is even an incorrect assumption, because Hellriegel's experiments show conclusively that there is a limit to the capacity of crops for absorbing water.

To assume that a selective process takes place based on physical properties alone and that the plant has the power to take up more water-soluble phosphoric acid than water in which it is dissolved independent of chemical action or solvent power is not correct. Because if such a purely physical action were to take place, the ions of lime, magnesia, etc., forced back into the solution by the withdrawal of the PO_4 ions would make the remaining phosphoric acid less soluble. In fact, purely physical action based upon ionization, as claimed by the authors, would be working *against* the plant instead of aiding it in securing plant food.

Most of the data given in Bulletin No. 22 point to just the opposite conclusions from those drawn. It is stated that there are no material differences in the amounts of water-soluble plant food present in soils producing the largest and the smallest crop yields. The figures in the bulletin conclusively show that on a purely physical basis the rich soils do not contain enough water-soluble plant food to account for all of the mineral matter found in the crop. There is only one alternative, namely, since the figures show that there is not enough water-soluble plant food to account for all that there is present in the crop, it must be derived from other and insoluble forms. In fact, no better evidence could be given showing such a conclusion to be logical than the tables in Bulletin No. 22. In short, the conclusions are entirely at variance with the tables.

HARRY SNYDER.
AGRICULTURAL EXPERIMENT STATION,
ST. ANTHONY PARK, MINN.

THE EDISON MEDAL.

THROUGH the efforts of an organization known as the Edison Medal Association, a fund has been created to establish a medal to be known as the 'Edison Medal,' and the responsibility of annually awarding it has been entrusted to the American Institute of Electrical Engineers.

The Edison Medal Association was founded by the friends and admirers of the great inventor, and in the language of the deed of gift, 'was organized for the purpose of properly recounting and celebrating the achievements of a quarter of a century in the art of electric lighting, with which the name of Thomas Alva Edison is imperishably identified,' and 'for the establishment of an Edison Medal, which should, during centuries to come, serve as an honorable incentive to the youth of America to maintain by their works the high standard of accomplishment by the illustrious man whose name and features shall live while human intelligence continues to inhabit the world.'

The gift was formally made, and the responsibility of conferring it assumed by the institute at its annual dinner given at the Waldorf-Astoria Hotel in New York, on February 11 last, held to not only commemorate the event, but also to celebrate the fifty-seventh anniversary of Mr. Edison's birth.

The fund has been deposited with the Continental Trust Company of New York, and there will be available this year sufficient funds for a medal, which will be awarded by a suitable committee of the institute, soon to be appointed.

The object of this letter is to attract the attention of the authorities of such institutions as may seem, to such authorities, qualified to compete; and the request is hereby made that all such institutions send, through their proper channels, their names to 'The Edison Medal Committee' of the American Institute of Electrical Engineers, 95 Liberty Street, New York City, on or before June 1, 1904, in order that the committee may have before it the names of all institutions which those in direct authority of them believe qualified to comply with the conditions as set forth in the various sections of the deed of gift, as follows:

Fourth. The Institute shall, so long as the requisite funds accrue from the said investments so to be made by the trust company, annually cause to be executed a gold medal, and shall, through a committee to be duly appointed and authorized by it and known as the Edison Medal Committee, award said medal in accordance with the provisions of this clause.

1. The medal shall be awarded to such qualified student as shall have submitted to the institute, in accordance with the provisions of this deed and of the regulations which may be prescribed by the Edison Medal Committee, the best thesis or record of research on theoretical or applied electricity or magnetism.

2. Each competitor for the medal, in order to be qualified, must have graduated and received a degree during the year for which the medal shall be awarded, in some course of study at some institution of learning in the United States of America or Dominion of Canada, which course of study shall include the branch of electrical engineering. The United States Naval Academy and Military Academy are included within the institutions from which competitors may be qualified.

3. Not more than two students may compete in any one year from any one institution of learning; nor may any student compete, unless duly presented for competition through the faculty of the particular institution at which he is a student.

4. The course of study must be one normally representing not less than two years of continuous residence and work.

5. The thesis or record must not exceed six thousand words, not inclusive of words employed in explanation of accompanying drawings.

6. No competitor shall be of greater age than twenty-five years at the day of his graduation in such course of study.

Fifth. The institute shall, through its Edison Medal Committee, forthwith make such rules and regulations, not inconsistent with any of the provisions or conditions of this deed, as may, in their judgment, assist in the proper execution of the trust herein created. The Edison Medal Committee shall immediately upon making such rules and regulations notify the institutions of learning open to competition, of such provisions of this deed, and of such rules and regulations as may properly be communicated to them, and through them to the students at such institutions.

Sixth. The institute will further, through its Edison Medal Committee, issue to each recipient of the Edison Medal a parchment certificate in such form as may be prescribed by said committee, certifying the name of the person to whom said medal is awarded, the date of such award, and such other facts as may be deemed proper by the committee.

The Edison Medal Committee is being selected from among the members of the institute who are not now connected with educational institutions, but who have the necessary early educational training, and subsequent experience, to enable them to critically analyze and justly determine the merits of the theses offered in the various fields of research. This committee will, after organization, communicate such further information as may be necessary to those institutions whose names have been presented in compliance with this invitation, and it is hoped that prompt response may be received in order that no institution justly entitled to consideration may be overlooked.

Bion J. Arnold,
President.

American Institute of
Electrical Engineers.

SCIENTIFIC NOTES AND NEWS.

At the annual meeting of the American Academy of Arts and Sciences, held on May 11, it was voted, on the recommendation of the Rumford committee, to award the Rumford medals to Professor Ernest Fox Nichols, of Columbia University, for his researches on radiation, particularly on the pressure due to radiation, the heat of the stars and the infra-red spectrum.

Professor Edward S. Morse has been elected a corresponding member of the

Swedish Society of Anthropology and Geography.

THE council of the Royal Astronomical Society has proposed as associates M. Henri Deslandres, of the Meudon Observatory, Professor C. D. Perrine, of the Lick Observatory, and Mr. George W. Ritchie, of the Yerkes Observatory.

PROFESSOR FRIEDRICH KOHLRAUSCH, president of the Reichsanstalt, has been elected a foreign member of the Danish Academy of Sciences.

PROFESSOR BARROIS, of Lille, the geologist, has been elected a member of the Paris Academy of Sciences.

THE University of Göttingen has awarded its Otto Wahlbruch prize, of the value of $3,000, to Dr. Wilhelm Pfeffer, professor of botany at Leipzig. The prize is awarded for the most important contribution to science during the past two years.

THE candidates selected by the council of the Royal Society have been elected as follows: Dr. T. G. Brodie, Major S. G. Burrard, Professor A. C. Dixon, Professor J. J. Dobbie, Mr. T. H. Holland, Professor C. J. Joly, Dr. Hugh Marshall, Mr. Edward Meyrick, Dr. Alexander Muirhead, Dr. G. H. F. Nuttall, Mr. A. E. Shipley, Professor M. W. Travers, Mr. Harold Wager, Mr. G. T. Walker and Professor W. W. Watts.

THE Royal Institution, London, has elected the following honorary members: Professor E. H. Amagat, Professor L. P. Cailletet, Professor J. M. Crafts, Professor H. A. Lorentz, Professor E. W. Morley, Professor E. C. Pickering, Professor and Madame Curie, Professor H. L. Le Chatelier, Professor G. Lippmann, Professor J. W. Bruhl, Professor G. H. Quincke, Professor E. Fischer, Professor F. W. G. Kohlrausch, Professor H. Landolt, Professor L. Boltzmann, Dr. H. Kamerlingh Onnes, Dr. G. Lunge, Professor P. T. Cleve and Professor P. Zeeman.

DR. W. SCHMID has been appointed director of the Bavarian National Museum at Munich.

PROFESSOR W. F. KING, chief astronomer for the Canadian government, is preparing to undertake the resurvey of the Alaskan boundary in accordance with the recent award of the Alaskan Commission.

M. ALFRED GRANDIDIER has been elected president of the French Society of Geography.

PROFESSOR HENRY B. WARD, of the University of Nebraska, will sail on June 11 for England. He expects to visit the university laboratories in England and on the continent and to attend the International Zoological Congress. He will not return to Lincoln until about September 15.

DR. ROBERT KOCH has arrived at Cairo from West Africa, and is being consulted by the Egyptian Sanitary Department on the epidemic of bovine typhus now prevalent in Egypt.

DEAN EDWARD C. KIRK, of the Dental School of the University of Pennsylvania, has been made chairman of the committee on organization of the fourth International Dental Congress, which is to be held at St. Louis from August 29 to September 3.

MR. R. W. WILLIAMS, JR., of the Biological Survey, will soon return to his home in Tallahassee, Florida, to resume the practise of law.

A JURY in Brooklyn has rendered a verdict of $20,000 damages in favor of Mr. Arthur MacDonald against the New York *Sun*. The *Sun* published numerous editorials attacking Dr. MacDonald while he was specialist on the defective classes of the U. S. Bureau of Education.

DR. WILLIAM OSLER, professor of medicine at the Johns Hopkins University, delivered on May 18 the Ingersoll lecture at Harvard University. His topic was 'Science and Immortality.'

PROFESSOR ROBERT FLETCHER, director of the Thayer School of Engineering, Dartmouth College, has addressed the students of the Worcester Polytechnic Institute on 'Our Personal Relation to Sanitary Science.'

THE Croonian lectures before the Royal College of Physicians of London will be delivered by Dr. J. Rose Bradford on June 7, 9, 14 and 16, his subject being 'Bright's Disease and its Varieties.'

It is stated in the *Condor* that Mr. W. L. Dawson, the author of 'The Birds of Ohio,' intends to move to the state of Washington, where he will undertake, in co-authorship with Mr. J. H. Bowles, of Tacoma, an illustrated work upon the 'Birds of Washington.'

The monument in honor of Benjamin Rush, presented to the nation by the American Medical Association, will be unveiled at Washington, on June 11, at four o'clock in the afternoon. There will be an introductory address by the president of the American Medical Association; an oration on Benjamin Rush by Dr. J. C. Wilson, Philadelphia, and an address of the president of the United States accepting the gift.

The fellowship established at the University of California in honor of the late Professor Joseph Le Conte has been awarded to C. O. Esterly, at present assistant in zoology at the University.

News has just been received by cable that Professor E. J. Marey died on May 16. Physiology has thus lost one of its ablest exponents and a leader in the application of methods of physical research to the study of biological phenomena.

Professor Wilhelm Hiss, professor of anatomy at Leipzig and eminent for his contributions to that science, died on May 1, at the age of seventy-two years.

Dr. George Johnston Allman, F.R.S., for more than forty years professor of mathematics in Queen's College, Galway, has died at the age of eighty years. He was the author of numerous contributions to mathematics, especially on the history of the science.

We regret also to record the death of M. Emile Godfernaux, a well-known French civil engineer, and of M. Charles Soret, who held, since 1879, a chair at the University of Geneva, first of mineralogy and then of physics, on April 4.

Frederick A. Walpole, the botanical artist of the Department of Agriculture, died on May 11, 1904, of typhoid fever, at Cottage Hospital, Santa Barbara, Cal. He was considered the best plant artist in the United States, his drawings having been used to illustrate various reports published by the Department of Agriculture and the Smithsonian Institution, as well as the narrative of the Harriman Alaska expedition. Mr. Walpole was born in Essex County, New York, in 1861, and at an early age moved with his parents to Illinois and later to Portland, Oregon, where he was engaged for some years as artist of a lithographic establishment. In 1896 his drawings of plants came to the notice of the Department of Agriculture and procured for him the position which he has since occupied. His method was to make his drawings from living plants growing under their natural wild conditions. His summers were spent mainly in the field, and his winters at the National Herbarium in Washington, where he completed and perfected his work. The greater part of his drawings remain unpublished, including a remarkable series of colored paintings of the native poisonous plants of the United States, now on exhibition by the Department of Agriculture at St. Louis. He was a member of the American Association for the Advancement of Science, the National Geographic Society and the Biological Society of Washington.

There will be a civil service examination on June 8 for the position of civil engineer in the Philippine Service Bureau of Forestry, at a salary of $2,400. On June 15 there will be an examination for the position of laboratory assistant in the Bureau of Standards at a salary of $900.

The New York Civil Service Commission will hold examination on June 7, for director of Pathological Laboratories, Department of Bellevue and Allied Hospitals, New York City. The salary is $5,000 a year; the successful candidate will be required to devote all his time to the work.

Colonel J. E. Thayer, of Lancaster, Mass., is erecting a museum in that town to contain his valuable collection of birds.

Mr. E. R. Thomas has given $40,000 to the Manhattan Eye, Ear and Throat Hospital, which makes available conditional gifts amounting to $125,000.

THE proposal has been made to erect in Albany, N. Y., an institution, to cost $1,250,000. It is intended for a home for the Albany Institute and Historical and Art Society, as well as the research center of the newly organized society of engineers of eastern New York.

THE sixth International Zoological Congress will, as has already been announced, be held at Berne from August 14 to 19. The congress will be invited to hold its next session in the United States.

IN connection with the mathematical congress which will be held at Heidelberg from August 8 to 13, there will be an exhibition of the mathematical literature of the past ten years, to which mathematicians are invited to contribute. Further information may be obtained from Dr. A. Gutzmer, University of Jena.

WE take from the *Medical News* the following facts in regard to the program of the American Medical Association which meets at Atlantic City from June 7 to 10. On Tuesday evening, beside the Oration on Medicine, the title of which is 'The Importance of Pathologic Anatomy in Clinical Medicine,' by Dr. George Dock, Ann Arbor, Mich., there will be a symposium on research work in the United States. Dr. J. S. Billings, New York, will give an account of the work being done by the Carnegie Institution; Dr. L. Emmett Holt, New York, will speak of the Rockefeller Institute; Dr. Frank Billings, Chicago, of the Memorial Institute for Infectious Diseases; Dr. Harold C. Ernst, Boston, concerning the research work at Harvard, and Dr. Alfred Stengel concerning the William Pepper Clinical Laboratory. On Wednesday evening Dr. W. J. Mayo, Rochester, Minn., will deliver the Oration on Surgery, entitled 'The Association of Surgical Diseases in the Upper Abdomen.' This will be followed by a symposium on 'The Mutual Relation and Duties of the Government Medical Services and the Medical Profession.' Dr. Victor C. Vaughan will talk on the subject 'What Can the Medical Departments of the Army, of the Navy, and of the Public Health and Marine-Hospital Service do for Medical Science?' Surgeon-Major William C. Borden, U. S. Army, will speak on 'What Can the Medical Profession do for the Army?' Surgeon C. F. Stokes, U. S. Navy, will speak for the Navy, and Surgeon-General Walter Wyman will speak for the Public Health and Marine-Hospital Service. On Thursday evening the oration on State Medicine will be delivered by Dr. Herman M. Biggs, New York City, on 'Preventive Medicine; its Achievements, Scope and Possibilities.' Following this will be a symposium in which Dr. William H. Welch, Baltimore, will speak in 'The Bureau of Animal Industry; its Service to Medical Science'; Dr. D. E. Salmon, Washington, D. C., on 'The Service of the Medical Profession to the Bureau of Animal Industry,' and Dr. H. W. Wiley, Washington, D. C., on 'The Bureau of Chemistry and Medical Science.' These evening meetings will be held on Young's Pier, so there will be ample room for the large number that will certainly attend them.

ACCORDING to Mr. George Otis Smith, of the United States Geological Survey, who is the author of a geologic folio on the Mount Stuart (Washington) quadrangle, there is likely to be an increase in the future in the gold production of that area. Mining operations in that field have heretofore been in the hands of people with limited capital, but during the last five years the claims of the small operators have been purchased by large companies, and it is probable that the mines will now be worked more steadily and more economically. The three principal gold-mining districts of central Washington are in this quadrangle. The Peshastin placers were discovered in 1860 and have been worked intermittently ever since. The Swauk placers have been worked rather more steadily since their discovery in 1868. Gold-bearing veins were first located in the Peshastin district in 1873, and in the Swauk district in 1881. Copper and silver occur with the gold in some of the veins of the Negro Creek district. Many of the ores are essentially copper ores, but whether the bodies are extensive enough to warrant their development has not yet been determined. Nickel is also a metal frequently

reported in the assays from this district. The Roslyn Basin is the most productive coal field in the Pacific coast states and it is included mostly within this quadrangle. The coal is a coking, bituminous coal, well adapted for steam raising and gas making. Its clean character and its high percentage of lump fit it for shipment as well as for local use.

UNIVERSITY AND EDUCATIONAL NEWS.

In the thirtieth general assembly of Iowa, recently adjourned, an attempt was made to remove the departments of engineering from the State University at Iowa City to the State College of Agriculture at Ames. The measure was promptly killed by the vigorous action of the alumni and other friends of the university and an appropriation of $50,000 was made for erecting either the first of a new series of engineering buildings or the wing of a single large engineering hall. An additional appropriation was made for constructing a dam in the Iowa River which will yield on the average over three hundred horse power. This power will be used for lighting and ventilating the university buildings, besides supplying power to the various engineering shops and laboratories. Plans for the proposed structures are being made and work will be commenced at the earliest possible date. An additional $5,000 was appropriated for the better equipment of the bacteriological laboratory, which sum will be increased from the general support fund of the university. Ground will at once be broken for a new museum building to cost about $225,000. The present natural science building of brick, completed in 1885 at a cost of $45,000, will be moved bodily to a new site to make room for the proposed structure, this being in accordance with plans formed several years since for the development of the university buildings and grounds. The new medical buildings are nearing completion and are already partially occupied. All the new buildings are massive fireproof structures, finished in Bedford stone and thoroughly modern in every detail. The total income of the university for the next biennium will exceed $960,000, about one third of which must be used for building.

According to the New York *Evening Post* the Association of Class Secretaries of the Massachusetts Institute of Technology, which is active in opposition to the proposed union of the Institute with Harvard University, reports that over 2,000 of the alumni have signed the petition on the subject addressed to the corporation. Ninety-five per cent. of the graduates approached on the subject sign the adverse petition without qualification, or with unimportant modification; three per cent., while advocating the independence of the Institute, decline to sign because they rely on the judgment of the corporation, or consider the petition too sweeping; and two per cent. decline to sign because they believe that some combination of effort may be possible, or that a union with Harvard is desirable.

The Cornell College of Agriculture is to add a school of landscape gardening to its curriculum.

We learn from the London *Times* that the president of the board of education has appointed a departmental committee to inquire into the present working of the Royal College of Science, including the School of Mines; to consider in what manner the staff, together with the buildings and appliances now in occupation or in course of construction, may be utilized to the fullest extent for the promotion of higher scientific studies in connection with the work of existing or projected institutions for instruction of the same character in the metropolis or elsewhere; and to report on any changes which may be desirable in order to carry out such recommendations as they may make. Sir Francis Mowatt, G.C.B., is chairman of the committee, and Mr. J. C. G. Sykes, assistant secretary in the branch of the board which deals with evening schools, technology and higher education in science and art, has been appointed secretary to the committee.

Dr. William Stirling, professor of physiology in the University of Manchester, has been appointed dean of the Medical School.

Dr. R. Brauns, professor of geology and mineralogy at Giessen, has been called to Kiel.